

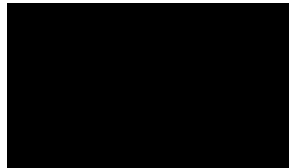
American Water Works Association

ANSI/AWWA C301-99

(Revision of ANSI/AWWA C301-92)



AWWA STANDARD
FOR
PRESTRESSED CONCRETE PRESSURE PIPE,
STEEL-CYLINDER TYPE



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AMERICAN WATER WORKS ASSOCIATION

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Contents

All AWWA standards follow the general format indicated subsequently. Some variations from this format may be found in a particular standard.

SEC.	PAGE	SEC.	PAGE
Foreword		4.3	Data to Be Submitted by Manufacturer.....5
I	Introduction.....vii	4.4	Materials.....6
I.A	Background.....vii	4.5	Design.....9
I.B	History.....vii	4.6	Fabrication.....11
I.C	Acceptance.....vii	4.7	Fittings and Special Pipe.....19
II	Special Issues.....viii	5	Verification
III	Use of This Standard.....viii	5.1	Inspection and Testing by Purchaser....21
III.A	Purchaser Options and Alternatives... ix	5.2	Tests.....22
III.B	Modification to Standard.....ix	6	Delivery
IV	Major Revisions.....ix	6.1	Marking.....22
V	Comments.....x	6.2	Transportation.....22
Standard		6.3	Affidavit of Compliance.....22
1	General	Table	
1.1	Scope.....1	1	Minimum Thickness of Sheet or Plate for Fittings of Various Diameters.....20
1.2	Purpose.....2		
1.3	Application.....2		
2	References 2		
3	Definitions 4		
4	Requirements		
4.1	Permeation.....5		
4.2	Plans and Data to Be Furnished by Purchaser.....5		

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Foreword

This foreword is for information only and is not a part of AWWA C301.

I. Introduction.

I.A. *Background.* There are two types of prestressed concrete steel-cylinder pipe: (1) the lined-cylinder type, with a core composed of a steel cylinder lined with concrete and subsequently wire-wrapped directly on the steel cylinder and coated with mortar; and (2) the embedded-cylinder type, with a core composed of a steel cylinder encased in concrete and subsequently wire-wrapped on the exterior concrete surface and coated with cement mortar. The lined-cylinder type, which was first used in the United States in 1942, is furnished in sizes from 16 in. (410 mm) to 60 in. (1,520 mm). The embedded-cylinder type, which was developed later and first installed in 1953, is most commonly manufactured in sizes 48 in. (1,220 mm) and larger.

Both types are designed for the specific combination of internal pressure and external load required for the project in accordance with the procedures outlined in ANSI/AWWA C304, Standard for Design of Prestressed Concrete Cylinder Pipe.

Prestressed concrete steel-cylinder pipe is used for transmission mains, distribution feeder mains, pressure siphons (including river crossings), penstocks, industrial pressure lines, water intake lines, and other applications.

In the manufacture of lined-cylinder pipe, the first step is to fabricate and hydrostatically test the steel cylinder with joint rings attached. The cylinder is then lined with concrete to form the core. The concrete is placed either centrifugally, by vertical casting, or by a radial compaction method. The concrete lining is cured and high-tensile wire is wrapped around the core directly on the steel cylinder. For a selected wire size, the tension and spacing of the wire are controlled to produce a predetermined residual compression in the core to meet design requirements. The wrapped core is then covered with a dense premixed mortar coating applied by a mechanical impact method.

In the manufacture of embedded-cylinder pipe, the cylinder and joint rings are constructed and tested in the same manner as lined-cylinder pipe. The cylinder is encased in concrete by vertical casting and mechanical vibration to constitute the core. After curing, the wire reinforcement is wound under tension in one or more layers around the outside of the concrete core containing the cylinder, instead of directly on the cylinder. The exterior coating of premixed mortar is placed by impaction.

Installation of this pipe is covered by AWWA Manual M9, *Concrete Pressure Pipe*.

I.B. *History.* The first edition of this standard was approved as tentative on Nov. 21, 1949. It was revised and made standard June 13, 1952. The second edition was approved as tentative June 17, 1955, and made standard June 26, 1958. Substantial changes, including the addition of combined loading procedures, were included in the third edition, which was made standard Jan. 27, 1964. The standard was revised again on Jan. 31, 1972; June 24, 1979; Jan. 30, 1984; and June 22, 1992. This edition was approved by the AWWA Board of Directors on Jan. 24, 1999.

I.C. *Acceptance.* In May 1985, the US Environmental Protection Agency (USEPA) entered into a cooperative agreement with a consortium led by NSF International (NSF) to develop voluntary third-party consensus standards and a

certification program for all direct and indirect drinking water additives. Other members of the original consortium included the American Water Works Association Research Foundation (AWWARF) and the Conference of State Health and Environmental Managers (COSHEM). The American Water Works Association (AWWA) and the Association of State Drinking Water Administrators (ASDWA) joined later.

In the United States, authority to regulate products for use in, or in contact with, drinking water rests with individual states.* Local agencies may choose to impose requirements more stringent than those required by the state. To evaluate the health effects of products and drinking water additives from such products, state and local agencies may use various references, including

1. An advisory program formerly administered by USEPA, Office of Drinking Water, discontinued on Apr. 7, 1990.
2. Specific policies of the state or local agency.
3. Two standards developed under the direction of NSF, ANSI/NSF[†] 60, Drinking Water Treatment Chemicals—Health Effects, and ANSI/NSF 61, Drinking Water System Components—Health Effects.
4. Other references including AWWA standards, *Food Chemicals Codex*, *Water Chemicals Codex*,[§] and other standards considered appropriate by the state or local agency.

Various certification organizations may be involved in certifying products in accordance with ANSI/NSF 61. Individual states or local agencies have authority to accept or accredit certification organizations within their jurisdiction. Accreditation of certification organizations may vary from jurisdiction to jurisdiction.

Appendix A, “Toxicology Review and Evaluation Procedures,” to ANSI/NSF 61 does not stipulate a maximum allowable level (MAL) of a contaminant for substances not regulated by a USEPA final maximum contaminant level (MCL). The MALs of an unspecified list of “unregulated contaminants” are based on toxicity testing guidelines (noncarcinogens) and risk characterization methodology (carcinogens). Use of Appendix A procedures may not always be identical, depending on the certifier.

AWWA C301-99 does not address additives requirements. Thus, users of this standard should consult the appropriate state or local agency having jurisdiction in order to

1. Determine additives requirements including applicable standards.
2. Determine the status of certifications by all parties offering to certify products for contact with, or treatment of, drinking water.
3. Determine current information on product certification.

II. Special Issues.

This standard has no applicable information for this section.

III. Use of This Standard. AWWA has no responsibility for the suitability or compatibility of the provisions of this standard to any intended application by any

*Persons in Canada, Mexico, and non-North American countries should contact the appropriate authority having jurisdiction.

[†]American National Standards Institute, 11 W. 42nd St., New York, NY 10036.

[‡]NSF International, 3475 Plymouth Rd., Ann Arbor, MI 48106.

[§]Both publications available from National Academy of Sciences, 2102 Constitution Ave. N.W., Washington, DC 20418.

user. Accordingly, each user of this standard is responsible for determining that the standard's provisions are suitable for and compatible with that user's intended application.

III.A. *Purchaser Options and Alternatives.* Purchasers are advised that, while this standard presents information on materials and procedures for manufacture of the pipe, it does not contain all of the engineering information needed to prepare a complete specification for a particular pipeline installation. A specific installation may require provisions more restrictive than those in the standard and most certainly will require additional design and installation features.

Reference to AWWA Manual M9, Concrete Pressure Pipe, should be considered as a supplement to the use of this standard, and information in the manual should not be regarded as superseding any portion of this standard. The purpose of Manual M9 is to provide information concerning some of the various subjects to be considered in, and the minimum standard of practice for, the design and installation of concrete pressure pipelines.

When purchasing pipe under the provisions of this standard, the purchaser's specifications shall include specific details, where applicable, regarding the following:

1. Standard used—that is, AWWA C301, Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, of latest revision.
2. Manner of storage and delivery, if required of the manufacturer.
3. Working pressure, surge pressure, field test pressure, external loading conditions, and method of bedding and backfilling (Sec. 4.2.1).
4. If detailed drawings and schedules are to be submitted for review (Sec. 4.3.1 and 4.7.1).
5. If manufacturer is not permitted to supply pipe from inventory (Sec. 4.3.1).
6. If a tabulated layout schedule will be required (Sec. 4.3.2).
7. If any material or manufacturing test reports will be required (Sec. 4.4, 5.1.2, and 5.2).
8. Type of cement required, if there is a preference (Sec. 4.4.1.1).
9. If the manufacturer is not permitted to use pozzolanic materials as a cement replacement (Sec. 4.4.1.1).
10. If aggregate samples will be required (Sec. 4.4.4).
11. If the manufacturer is not permitted to use admixtures (Sec. 4.4.6).
12. If submission of manufacturer's verification of design will be required (Sec. 4.5.2.1).
13. If submission for approval of welder qualification (Sec. 4.6.2) and welding procedure specifications (Sec. 4.6.3) will be required.
14. If details of specials and fittings are to be furnished by the manufacturer (Sec. 4.7.1).
15. If the purchaser desires to inspect the material, pipe, and fittings at the manufacturer's plant (Sec. 5.1.1).
16. If steel test specimens will be required (Sec. 5.2.6).
17. If an affidavit of compliance will be required (Sec. 6.3).

III.B. *Modification to Standard.* Any modification to the provisions, definitions, or terminology in this standard must be provided in the purchaser's specifications.

IV. Major Revisions. Major changes made to the standard in this revision include the following:

1. The format has been changed to AWWA standard style.

2. The acceptance clause (Sec. I.C) and the definitions of parties (Sec. 3) have been revised to approved wording.
3. A new Sec. 1.2. "Purpose," has been added.
4. A new Sec. 1.3 "Application," has been added.
5. Silica fume has been added as an acceptable cement replacement for concrete in the pipe core (Sec. 4.4.1).
6. The frequency of specific gravity measurement for coarse aggregate has been changed (Sec. 4.4.3).
7. Thickness tolerance variations/limits for plates, sheets, and coils has been expanded (Sec. 4.4.7.6).
8. Prestressing wire additional testing requirements have been deleted; these requirements are now in ASTM A648 Standard (Sec 4.4.8.1).
9. A limit for carbon equivalency has been added to steel bars (Sec. 4.4.8.2).
10. Pipe size in lieu of pipe type has been added to the joint rings dimension and tolerances section. Also, treatment of burrs and sharp edges of the joint-ring surface has been added (Sec. 4.5.3.2).
11. A new section for Welding Procedure Specifications has been added (Sec. 4.6.3).
12. Cylinder weld sampling for helical machines and flat sheet fabrication has been established (Sec. 4.6.4.2).
13. Performance criteria relative to the properties of concrete specified in AWWA C304 has been added (Sec. 4.6.5.2).
14. A maximum limit for water-cement ratio of concrete placed by the vertical cast or radial compaction process has been established (Sec. 4.6.5.2).
15. An alternative cylinder size for concrete test cylinders has been added (Sec. 4.6.5.5).
16. A guideline for collecting concrete samples used in making concrete test cylinders was established (Sec. 4.6.5.5).
17. Measurement for unit weight of concrete section has been deleted (former Sec. 3.6.13).
18. Section on accelerated curing of the pipe core was refined to allow sealing compound and to better define temperature limitations (Sec. 4.6.6.2).
19. Strength test requirement for wire splices has been added (Sec. 4.6.7.1).
20. The section on cracks of pipe cores has been replaced by an expanded section covering limitations on cracks in pipe cores and mortar coating (Sec. 4.6.10).
21. Section on repair of concrete and mortar has been expanded (Sec. 4.6.11).
22. Reference to AWWA C208 in the fittings design section has been replaced by a reference to AWWA Manual M9 (Sec. 4.7.2.1).

V. Comments. If you have any comments or questions about this standard, please call the AWWA Volunteer and Technical Support Group, (303) 794-7711 ext. 6283, FAX (303) 795-7603, or write to the department at 6666 W. Quincy Ave., Denver, CO 80235.



AWWA STANDARD FOR PRESTRESSED CONCRETE PRESSURE PIPE, STEEL-CYLINDER TYPE

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard covers the manufacture of circumferentially prestressed concrete pressure pipe with a steel cylinder and wire reinforcement in sizes 16 in. (410 mm) through 144 in. (3,660 mm). Larger sizes have been manufactured based on the concepts presented in this standard. The standard covers two types of prestressed pipe: (1) lined-cylinder pipe with a core composed of a steel cylinder lined with concrete and subsequently wire-wrapped and coated with premixed mortar, and (2) embedded-cylinder pipe with a core composed of a steel cylinder encased in concrete and subsequently wire-wrapped and coated with premixed cement mortar. The design of prestressed concrete pipe is not presented in this standard, but is the subject of ANSI/AWWA C304, Standard for the Design of Prestressed Concrete Cylinder Pipe. AWWA C301 also does not include requirements for handling, delivering, laying, field testing, or disinfecting of pipe. See AWWA Manual M9, *Concrete Pressure Pipe*, for this information.

1.1.1 *Essential requirements.* The pipe shall have the following principal features: a welded steel cylinder with steel joint rings welded to its ends; for lined-cylinder pipe, a core consisting of a lining of concrete within the steel cylinder, or for embedded-cylinder pipe, a core consisting of the steel cylinder encased in concrete; reinforcement consisting of high-tensile wire wound around the outside of the core in one or more layers at a predetermined stress and fastened securely at its ends; a coating of dense mortar covering the core and wire, except for the necessarily exposed surfaces of the joint rings; a self-centering joint with a preformed gasket of rubber, designed so that the joint will be watertight under all conditions of service. Lined-cylinder pipe shall be used for pipe sizes up to and including 20 in. (510 mm) and may be used for pipe sizes up to and including 60 in. (1,520 mm). Embedded-cylinder pipe may be used for pipe sizes 24 in. (610 mm) through 60 in. (1,520 mm) and shall